SECTION 905(b) (WRDA 1986) ANALYSIS

Ocean Shores, Washington

Shore Protection and Storm Damage Reduction

US Army Corps of Engineers®
Seattle District

CITY OF OCEAN SHORES WASHINGTON

Ocean Shores, Washington (PWI 014335)

Section 905(b) (WRDA 1986) Analysis

1. STUDY AUTHORITY. Study resolution adopted 9 October 1998 by the Committee on Transportation and Infrastructure of the United States House of Representatives:

> *"Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That is accordance with Section 110 of the River and Harbor Act of 1962, the Secretary of the Army is requested to review the feasibility of providing shore protection improvements at Ocean Shores, Washington, in the interest of storm damage reduction, beach erosion, and related purposes."*

For the reconnaissance study, Congress added $100,000 to the FY 1999 Energy and Water Development Appropriations Act. For the feasibility study, Congress added $100,000 to the FY 2000 Energy and Water Development Appropriations Act, together with the following directive language, to initiate the cost share feasibility phase study:

> *HR 36: "Ocean Shores, Washington. – The Committee has provided funding to initiate a feasibility study of storm damage reduction alternatives for the City of Ocean Shores in Grays Harbor County, Washington."*

2. STUDY PURPOSE. Hurricane and storm damage reduction. The study will address protection of privately owned developed lands and associated non-Federal publicly owned lands and infrastructure. The shore is publicly owned and is administered for public use. This report addresses the requirements of Section 905(b) of the Water Resources Development Act (WRDA) of 1986, as amended.

3. LOCATION OF PROJECT/CONGRESSIONAL DISTRICT. City of Ocean Shores, Grays Harbor County, Washington. Congressional District: WA-06.

The City of Ocean Shores is located on a 6,000-acre peninsula that forms the northern shore of the Grays Harbor estuary (see Figure 1). The City is bordered by the Pacific Ocean on the west and by North Bay of Grays Harbor on the east. Ocean Shores is approximately 100 miles southwest of Seattle, 72 miles from the state capitol of Olympia, and 20 miles from Hoquiam. Grays Harbor is a pear-shaped shallow tidal estuary at the mouth of the Chehalis River in the southwestern part of Washington, 45 miles north of the mouth of the Columbia River. Two long spits enclose the ocean side of the estuary, Point Brown on the north and Point Chehalis on the south. The two convergent dumped-rock jetties, south jetty (completed in 1902) and north jetty (completed in 1913) extend seaward from Point Chehalis and Point Brown,

respectively, constricting the harbor entrance width to about 6,500 feet. The north jetty forms the southern boundary of the City of Ocean Shores. Following construction of the north jetty, the North Beach sub-cell prograded rapidly along its southern end, accreting approximately 8 square kilometers of land within 6 kilometers of the north jetty. The northern and eastern portion of the city, including the entire commercial district, is situated on land that existed prior to construction of the Grays Harbor jetties. The southern portion of the city, including the actively eroding shoreline and flood-prone area, is accreted land.

4. DISCUSSION OF PRIOR STUDIES, REPORTS AND EXISTING WATER PROJECTS.

A. Grays Harbor Navigation Project. The Grays Harbor navigation project is an existing deep-draft navigation project and is sponsored by the Port of Grays Harbor. In addition to an authorized and constructed 30-foot deep, 24-mile long navigation channel that extends to Aberdeen and Cosmopolis, the project includes the 16,000-foot-long north jetty, the 13,734-foot-long south jetty, and related improvements. The original project was authorized by the River and Harbor (R&H) Act of 3 June 1896 and included channel improvements and the south jetty (completed in 1902). The R&H Act of 2 March 1907 authorized construction of the north jetty (completed in 1913). The R&H Act of 30 August 1935 combined former individually authorized projects into a modified project for Grays Harbor and Chehalis River. Recent navigation improvements, which included widening and deepening 24 miles of channel and turning basins, were authorized and constructed in accordance with Section 202 of the Water Resources Development Act of 1986 (Public Law 99-662). The deep-draft navigation channel crosses the ocean bar and parallels the north side of the south jetty.

B. Southwest Washington Coastal Erosion Study. This important study is a Federal-State-Local cooperative research program to address the coastal geology, processes, and natural hazards of the Southwest Washington coast. The five-year study was initiated in FY 1996 and is jointly funded by the US Geological Survey (Marine and Coastal Geology Program) and the Washington Department of Ecology, with participation by the Corps' Seattle and Portland District offices and numerous state and local governmental agencies. The study involves field investigations and data analysis to develop a regional perspective and scientifically based understanding of coastal processes, sediment transport, and associated shoreline changes. The study is also examining the effects of man-made influences (e.g., enhances runoff, dredging operations, Columbia River dams, jetties, and shoreline armoring) and natural processes (e.g., climate variability, co-seismic subsidence, coastal dune development) on sediment budgets and on the long-term shoreline change trends and stability of the southwest Washington coast. The study area includes the 163-kilometer littoral cell from Tillamook Head, Oregon to Point Grenville, Washington. The study has been undertaken in response to intensifying erosion along the southwest coast of Washington, and will develop solid technical data and analysis of the littoral system to support formulation and implementation of cost-effective solutions to erosion problems, managing resources, protecting life and property, and preventing costly damage. These data and analyses will be used in the feasibility study.

C. City of Ocean Shores Long Term Coastal Erosion Management Strategy: Draft Environmental Impact Statement, May 28, 1999. The draft State Environmental Policy Act (SEPA) EIS was the City's first major step towards deciding what steps can and should be taken to manage the shoreline erosion, tidal flooding and associated storm damage threat to the City's western and southern boundaries. This process, which was initiated prior to funding and initiation of the GI reconnaissance study, had two purposes. First, the EIS was to help the City select one or more alternatives to address the immediate coastal erosion, tidal flooding and associated storm damage problem impacting a portion of the City. Second, the EIS was to help the City develop a long-term strategy for management of the erosion of accreted lands that make up the western boundary of the City along the Pacific Ocean so it is prepared to handle future erosion issues. As the feasibility study progresses, the City's draft EIS will evolve into a NEPA/SEPA EIS that will be developed in conjunction with the feasibility report. An economic impact study prepared by the City's consultant in conjunction with the EIS will also be utilized in the feasibility study.

D. Shoreline Change Modeling by Washington Department of Ecology. The Washington Department of Ecology (Ecology) has performed shoreline change modeling for the City of Ocean Shores to use as a planning tool in the development of a long-term solution to active shoreline erosion. The shoreline change model UNIBEST (Uniform Beach Sediment Transport), developed by Delft Hydraulics of the Netherlands, was applied to the North Beach sub-cell of the Columbia River littoral cell extending from the north jetty to Point Grenville. UNIBEST runs have been made with both linear shoaled and refracted waves and waves that were shoaled using the wave propagation model SWAN (Delft University of Technology). The model has been used to study historical shoreline change and to make future predictions and is undergoing continual refinement and calibration by Ecology staff. Preliminary results of this modeling were utilized in the City's draft EIS discussed above. The preliminary estimate indicates a shoreline position north of the north jetty in 2050 approximately 825 feet eastward of the 1995 shoreline position. We will utilize model outputs in the feasibility study, subject to further analysis and validation by Coastal and Hydraulics Laboratory staff at WES.

E. Establishment of Numerical Models of Grays Harbor. Numerical models of the waves, currents and sediment transport are being established for the entrance and bay at Grays Harbor. This work is being performed for Seattle District by the Coastal and Hydraulics Laboratory, U.S Army Engineer Research and Development Center at Vicksburg, Mississippi. The models are being ground-truthed with measurements made of the waves, wind, water level, currents and suspended sediment, supplemented by dredging records. Information gained through this investigation will be used primarily to assist the Corps in the design and maintenance of the Grays Harbor navigation project.

F. Corps of Engineers North Jetty Condition Survey. Seattle District performed a detailed topographic and bathymetric survey of the north and south jetties in 1996. The District used multi-beam side-scan sonar for the bathymetric survey and aerial photography for the topographic portion of the survey. A new aerial survey was conducted in the summer of 1999 for use in conjunction with jetty maintenance construction.

5. PLAN FORMULATION.

A. Identified Problems. The purpose of this section is to provide an assessment of water and related land resources problems and opportunities specific to the study area.

(1) Existing Conditions.

(a) Storm Damage to Upland Developments. The City of Ocean Shores is experiencing severe shore erosion and associated tidal flooding and storm damage to upland developments. This shore erosion is caused by wind- and tidal-generated waves and currents and threatens public and private property and development, public health and safety (i.e., operation of the wastewater treatment facility, risk of fire, risk of loss of life), public infrastructure (i.e., roads, utilities), and recreation and tourism opportunities. The area most affected is directly north of the Corps' Grays Harbor north jetty, an area designated as Management Area 1 by the City (see Photo 1). The latest shoreline erosion trend began around 1990, and the erosion rate has accelerated dramatically since 1994. The shoreline near the north jetty retreated approximately 35 feet during the six-month period from November 1995 to May 1996, threatening to breach the frontal dune. Continued erosion and eventual breaching of the frontal dune endangers commercial and numerous private residential developments located behind the dune, resulting in their destruction by erosion and undermining.

The shoreline erosion at Ocean Shores is a very serious and controversial problem for this destination/resort community. The controversy includes the cause and effect relationship between the Grays Harbor navigation project/north and south jetties and the accretion and erosion of land that makes up the 6,000-acre city of Ocean Shores. Although the area was not developed until 1960, it has grown rapidly, and now supports a population of 3,300 year-round residents. Tourism plays a critical role in the economy of Ocean Shores, and of Grays Harbor County as a whole. The city experiences a significant influx of seasonal residents primarily during the spring and summer, with tourism resulting in 2.5 to 2.8 million visitors each year.

(b) Temporary Shoreline Erosion Control Structures. In 1996, the City declared an emergency exemption under the State Shoreline Management Act, thereby enabling several property owners threatened by frontal dune erosion to privately finance construction of an 850-foot-long temporary rubblemound "wave bumper" on the public beach. The wave bumper structure consists of armor rock and associated gravel and clay fill material placed on the upper beach at the base of the severely eroding frontal dune (see photos 2-4). The structure was intended as an interim measure to deflect wave energy and protect the toe of a portion of the frontal dune from further erosion and prevent a number of oceanfront condominium developments on and immediately behind the frontal dune from being undermined and toppling onto the beach.

In January 1998, a major storm event and high tide resulted in severe flanking erosion on both the north and south ends of the wave bumper (see Photos 5-6). The City declared another emergency under the Shoreline Management Act to exempt the temporary emergency placement of two sand-filled geotextile tubes on the beach at the toe of the frontal dune scarp. The tubes were placed by the City in December 1998 and extend nearly 600 feet north of the wave bumpers (see photo 2). These temporary structures protect only a small portion of the threatened area, and are not intended as a long-term response to the shoreline erosion problem. The Memorandum of Agreements (MOA) with the State of Washington Parks and Recreation Commission for both temporary structures expire on 15 May 2000, at which time the structures must be either removed or the MOA extended until a long-term erosion control strategy can be implemented.

(c) Jetty Overtopping. A second, but related, storm damage problem involves winter storm surge overtopping of the Corps' north jetty. In April 1997, and again on three occasions between January and early March 1999, the jetty was overtopped by storm-driven waves and high ocean swells. These winter storm events typically originate from the southwest and combine a low-pressure system with very heavy seas, gale-force winds with gusts reaching 60 to 70 miles per hour, and unusually high tides. Storms such as these cause extensive wave run-up and overtopping, serious shore erosion, and widespread flooding of the area of the city depicted in Photo 1.

The March 1999 event posed the most serious threat to life and property, with the most widespread flooding and floodwaters up to five feet in depth (see Photos 7-12). Strong west and southwest winds directed large waves toward the coast, coinciding with a higher than predicted tide. East Ocean Shores Boulevard, which runs parallel to the north jetty, sustained severe damage and underground utility vaults for electricity, telephone and cable television were flooded. The waves pushed stumps, logs and debris landward for more than two blocks. Floodwaters also eroded and scoured a broad channel parallel to the jetty (between East Ocean Shores Boulevard and the jetty) and threatened to erode and undermine the perimeter embankment of the City's new wastewater treatment plant and undermine the sewer outfall line. Residential development sustained damage from floodwaters and logs and other debris that were deposited by the storm surge. A public restroom and parking area near the jetty was destroyed by the March 1999 event.

These storm events heightened the awareness of City officials to the real threat of widespread flooding from a southwest storm overtopping the north jetty. Accordingly, a coastal flood warning issued on 27 October 1999 by the National Weather Service resulted in a request by the City for voluntary evacuation of 125 structures. The storm, which again came out of the southwest, coincided with a high tide at 4:00 AM on 28 October 1999, with waves of around 21 to 24 feet. It did result in considerable water surging over the north jetty, but with little flood damage compared to the March 1999 event.

(d) Wave Climate and Tidal Range. The beaches along the Washington coast endure one of the highest energy wave climates in the nation. A very high tidal range accompanies this extreme wave climate. Winter waves in the region average 3 meters (9.8 feet) in significant wave height, with a period of 12 seconds. Extreme wave heights in excess of 8 meters (26 feet) are recorded routinely during winter storm events. Summer waves average 1.5 meters (4.9 feet) and 8 seconds. There is also a distinct seasonality in monthly wave direction, with winter storm waves arriving from the southwest and the milder summer waves arriving from the northwest. The tidal range is very high, with a diurnal (daily) range slightly greater than 9 feet. The maximum tidal range is about 14 feet, with extreme measured tides from 1 - 2 feet higher than extreme predicted tides. Factors that account for extreme measured tides include the existence of a storm surge, and the effects of water temperature, currents and atmospheric disturbances such as an El Niño event. It is these extreme maximum tides that, together with extreme winter waves, increase the potential for severe erosion of the upper beach and dune scarp.

(e) Bathymetric Changes. Careful analysis of bathymetric data covering the 44-year-span between 1955 and 1999 reveals that there has been a significant loss of sediment from the harbor entrance and from the area to the north and south of the Grays Harbor jetties. Over 20 feet of sediment has been lost (i.e., eroded) from the central portion of the harbor entrance, and 5 to 10 feet has been eroded from a 15 square mile area to the north and south of the harbor entrance. Since 1955, the area south of the south jetty has lost 34 million cubic yards (CY), for an average loss rate of approximately 0.8 million CY/year. The area north of the north jetty has lost 24 million CY and the harbor entrance itself has lost 20 million CY. The erosion of sediment from the areas to the north and south of the jetties, as well as throughout the harbor entrance, is distinct, widespread, and persistent and is certainly a direct result of the jetties themselves. The results of this analysis are consistent with the overall findings of studies by the Battelle Memorial Institute (1992) and the Corps' Committee on Tidal Hydraulics (1995) that large quantities of sediment are being eroded from these areas. The long-term loss of this sediment from the region offshore of the Ocean Shores shoreline reduces the likelihood that the observed shoreline retreat is a short-term phenomenon that may soon reverse. The increasing frequency and severity of flooding due to overtopping of the north jetty may be related to two factors: a more severe wave climate caused by erosion of the Grays Harbor bar and by increased water levels associated with the Pacific interdecadal climate oscillation (El Nino and La Nina). The protection once afforded by the bar has been lost and the north jetty is now exposed to larger and more frequent ocean storm waves approaching from the southwest.

(2) Expected Future Conditions. Under without project conditions, the storm damage and flood hazard will become progressively worse. The north jetty will continue to be overtopped by storm surges, resulting in flooding and related storm damage to the majority of the area identified as Management Area 1 on Figure 2. As the ocean shoreline continues to recede, and erosion of the frontal dune will continue unabated until the dune is breached. The resulting storm-induced tidal flooding will compound the existing jetty-related tidal flooding problem by increasing the frequency and severity of storm-induced tidal flooding of the area. Flooding will destroy or damage residential development (138 single-family and 166 multi-family units), as well as public infrastructure and utilities and possibly endanger life and limb. In addition,

recreation and tourism will be reduced and environmental impacts could occur. Management Area 1 will be increasingly prone to flooding which results from storm events that approach from both the southwest and the northwest. Residential land and properties in Management Area 1 are valued at $60 - $65 million. Damage of this magnitude would likely discourage further development in nearby areas not subject to flooding or erosion, as well as reduce property values in and around the flood zone.

(3) Planning Objectives and Planning Constraints.

(a) Planning Objectives.

- Reduce or eliminate damage to upland developments caused by wind- and tidal-generated waves and currents in affected areas of the City of Ocean Shores, Washington.
- Develop a long-term strategy to manage the City's accreted lands through stable and reliable land use policies and development standards, thereby minimizing the potential for future erosion/development collisions to occur.

(b) Planning Constraints.

- Maintain the viability of the City of Ocean Shores, while minimizing adverse economic and financial impacts at all levels of government.
- Protect and enhance public recreational opportunities associated with coastal beaches.
- Provide a long-term solution that is engineeringly feasible, environmentally acceptable, and publicly acceptable.

(4) Specific Problems and Opportunities, with Emphasis on Problems Warranting Federal Participation in the Feasibility Study. There are two serious storm damage problems that must be addressed at Ocean Shores and which warrant federal participation in the feasibility study. The first problem is that of distinct and persistent erosion of the Pacific Ocean shoreline that threatens to breach the primary dune located immediately adjacent to the shoreline. In addition, jetty overtopping is an existing problem that causes flooding of the southern portion of the area depicted on Photo1. Breaching of the primary dune will result in more frequent and extensive storm-induced tidal flooding and result in extensive flood damage to, and possible loss of, existing public infrastructure (streets, underground utilities, new wastewater treatment plant), and residential development (138 single-family homes and 166 multi-family units) within the area shown on Photo 1. A long-term management strategy can be formulated and management measures implemented to reduce the risk of future storm-related flooding and property loss. Implementation of a long-term management strategy will also enable the City and private property owners alike to make appropriate future land use decisions. Doing so will reduce the potential for a repeat of the present situation where very recent development of property has occurred directly in the path of active shoreline erosion and associated storm-induced coastal flooding.

B. Alternative Plans. A wide range of alternative management measures have been identified, and analyzed and evaluated to some extent, by the City of Ocean Shores to address the immediate storm damage threat. This was done in cooperation with the State of Washington and Seattle District Corps of Engineers as part of the City's draft EIS process. These alternative management measures included the following:

- No action.
- Partial retreat from Management Area 1:
  - Remove selected infrastructure and structures from area threatened by erosion, with construction of an artificial dune to protect structures and infrastructure further inland.
  - Remove all infrastructure and structures from area threatened by erosion, but without construction of an artificial protective dune.
- Nourishment:
  - Direct/onshore beach nourishment.
  - Indirect/offshore beach nourishment.
- Structural alternatives:
  - Bulkheads/revetments.
  - Jetty modification.
  - Tidal structures (e.g., groin fields, perched beach, and various proprietary devices).
  - Floating breakwater.
  - Offshore reef.

Alternative management measures were evaluated in the City's draft EIS against a variety of criteria, including:

- Ability to reduce shore erosion (short- and long-term).
- Ability to reduce flooding and storm damage due to erosion and breach of the primary dune.
- Impacts to fish and wildlife.
- Impacts to recreation and tourism.
- Regulatory complexity.
- Impacts to local, regional and state economy.
- Cost (construction, land acquisition, and maintenance).

Following screening of alternatives against these criteria, the City's interagency/ interdisciplinary study team concluded that a number of alternative measures are either technically infeasible and/or environmentally unacceptable. Ocean Shores is located in an area of high wave energy and a high tidal range, as briefly described in Paragraph 5.A.(1) above. City officials and the general public have begun to gain a keener appreciation and profound respect for this coastal oceanographic regime. They recognize that long-term management measures to address shoreline erosion and associated storm damage must be feasible from an engineering

standpoint, provide a long-term solution, be environmentally acceptable, and be both economically justified and financially feasible. Many of the management measures identified and evaluated in the City's draft environmental impact statement are controversial and clearly do not meet the basic tests of engineering feasibility, longevity or environmental and regulatory acceptability. However, if new technical information becomes available that would demonstrate the viability and acceptability of these or other management measures, it will be fully considered during the feasibility study.

It is the Seattle District staff assessment, with input from staff at the City of Ocean Shores, U.S. Army Engineer Research and Development Center and Washington State Department of Ecology, that the following array of alternatives are potentially viable solutions to the identified problems and should be further evaluated in the feasibility study:

- No action.
- Direct/onshore beach nourishment.
- Shore parallel structures.
- Jetty modification.
- Partial retreat from Management Area 1 and creation of a protective dune.
- Full retreat from Management Area 1.
- Combinations of measures.

C. Preliminary Evaluation of Alternatives. These alternatives are individually described and discussed below.

- **No action.** Taking no action is the default choice. The planning process must convincingly demonstrate that involvement in some project is preferred over "no action." The no action alternative provides a baseline (i.e., the "without project" condition) for comparison with the other measures considered.

- **Direct/onshore beach nourishment.** Direct beach nourishment would entail mechanically obtaining and placing sand on the beach to restore and maintain a suitable beach profile and shoreline position. The beach fill would thereby reduce damage to upland developments through the sacrifice of project fill material. This measure would require periodic placement of approximately 1.6 million cubic yards of sand along a 6,200-foot long reach northward of the north jetty. Technical issues requiring further evaluation include finding a long-term sand source, sand placement technique, and renourishment frequency. Environmental concerns include habitat loss associated with obtaining required quantities of sand for initial and periodic nourishment, as well as those associated with placement on the beach. Beach nourishment would have significant environmental effects on intertidal and shallow subtidal resources. Impacts would need to be mitigated by such measures as timing of beach nourishment, placement technique, and providing replacement habitat.

Beach nourishment costs are estimated in the City's Draft EIS to range from $19 – $33 million for a five-year cycle, or $90 – $158 million over a 50-year period. The actual cost may be at the upper end of this range, due to the cost of obtaining sand for beach nourishment. Sand for initial construction as well as periodic nourishment is not available from maintenance dredging of the Grays Harbor navigation project. Possible sources of sand include Columbia River maintenance dredging or an offshore deposit.

Beach nourishment could restore and maintain the beach profile sufficient to be highly effective in reducing erosion impacts and associated storm damage that would otherwise result from erosion and breaching of the frontal dune along the ocean shoreline. To provide a complete solution to the identified shoreline erosion and storm damage problems, this measure would need to be combined with jetty modification described below. These two measures in combination could fully protect the property and infrastructure within Management Area 1, with no adverse economic impact on the City.

- **Shore parallel structures.** This measure includes bulkheads and revetments placed parallel to the shoreline to prevent further erosion and recession of the shoreline. It is presently estimated that an armored structure approximately 6,200 feet in length, extending northward from the north jetty, would be required. There are significant engineering issues, environmental impacts, and tourism/beach access and use issues associated with shoreline armoring that would have to be resolved for this category of alternatives to be considered a viable long-term management measure for this shoreline. However, there is considerable local support for consideration of shoreline armoring, and the feasibility report will need to document the pros and cons of this measure.

  Revetment costs are estimated in the City's Draft EIS to be in the range of $25 million for initial construction. Maintenance costs would be high, requiring up to $12 million for extensive rehabilitation every 10 years. The structure would have to be maintained to withstand prolonged and repeated wave attacks under high tide conditions, scour, undermining, outflanking, overtopping, and simple battering by wave attack. Total cost of a revetment is on the order of $70 million over a 50-year period. If beach nourishment were required to provide structure toe protection, or as mitigation, additional costs would be incurred. To provide a complete solution to the identified shoreline erosion and storm damage problems, this measure would need to be combined with jetty modification described below.

  A revetment/bulkhead could be designed and maintained to function effectively to protect the eroding and wave-impacted shoreline and thus the property and infrastructure within Management Area 1. This measure would, however, have significant adverse physical impact to the beach, including beach lowering, induced erosion at the ends of the structure, reduction of sand supply to feed the beach, restrictions on beach access, and visual and aesthetic impacts. These impacts would hurt tourism and thus create

moderate economic impacts in the community that relies heavily on tourism for its economic base. Significant environmental effects on intertidal and shallow subtidal resources would result, requiring extensive mitigation.

To provide a complete solution to the identified shoreline erosion and storm damage problems, this measure would need to be combined with jetty modification described below.

- **Partial retreat from Management Area 1 and construction of a protective dune.** Partial retreat would involve removing public infrastructure and private development from the area immediately threatened by shoreline erosion. A protective dune would be constructed at a position landward of the existing eroded frontal dune to protect remaining infrastructure and development from wave overtopping and flooding as the existing dune is breached by wave erosion. The man-made dune would be part of the sacrificial storm damage reduction system where loss of material is anticipated. The UNIBEST model work previously performed by the State of Washington would be refined and used as the basis to determine the appropriate position to construct a man-made protective dune. Determination of future shoreline position, together with an appropriate dune design, would provide a project with a 50-year economic life. The area seaward (westward) of the protective dune would revert to open space for recreation and/or wildlife habitat. The premise for this measure is that shoreline retreat will slow in the future such that periodic nourishment of the dune could provide the intended level of storm damage reduction.

  Costs of partial retreat are estimated in the City's Draft EIS to range from $33 - $39 million. This includes land acquisition, demolition costs, and dune construction. Land upon which to construct the artificial dune, as well as land located west of the dune, would be acquired. All structures and infrastructure to the west of the dune would subsequently be removed. An estimated 23 single-family homes and 145 multi-family developments with an assessed value of $25 million would need to be acquired and removed, plus associated streets and utilities. Numerous undeveloped lots would also be acquired.

  Partial retreat and construction of a protective dune could be a very effective measure to protect the remaining infrastructure, development, and undeveloped parcels located east of the dune. To provide a complete solution to the identified shoreline erosion and storm damage problems, this measure would need to be combined with jetty modification described below. The net effect would be the elimination of storm and flood damages in the protected portion of the area. Property values in the protected area would not continue to decline, and tax revenues would stabilize. Development in the protected area would likely increase with reduction in the storm damage threat. Tourism and recreation use of the beach should not experience any long-term impact.

- **Jetty modification.** Congress added funding ($3,000,000) and directive language in the FY 2000 Energy and Water Development Appropriations Act for the Corps to restore the landward portion of the north jetty to design dimensions. This portion of the jetty was last maintained in 1975. Maintenance will reduce (but not eliminate) the frequency and severity of flooding attributable to overtopping of the jetty. Additional structural measures will be evaluated in the feasibility study to further reduce storm damage attributable to the jetty, possibly by further raising the height of the jetty or by constructing a berm landward to retain and channel water away from residential development. Seaward extension (lengthening) of the jetty is not being considered. Future jetty modification for the purpose of storm damage reduction -- above and beyond the maintenance construction that is scheduled in FY 2000/2001 -- is estimated to range from $3 – $5 million.

  Jetty modification can be highly effective in reducing, if not eliminating, jetty-induced flooding and storm damage. It does not address the ocean shoreline erosion problem and thus would be combined with another measure to provide a complete solution to the identified problems at Ocean Shores. The feasibility study will determine if there is a Federal interest in recommending to Congress the addition of storm damage reduction as an authorized purpose of the Grays Harbor north jetty.

- **Full retreat from Management Area 1.** Full retreat would involve a staged evacuation of Management Area 1 by removal of all infrastructure and structures from the area threatened by erosion and subject to flooding and storm damage. This would ultimately involve removal of 138 single-family and 166 multi-family units, plus associated infrastructure. A large number of presently undeveloped lots would also be acquired. All remaining roads and public utilities would be rerouted as necessary. The road to the City's wastewater treatment plant would be raised to ensure year-round access. The evacuated area would be preserved as open space for recreation and/or wildlife habitat. Costs of full retreat are estimated in the City's Draft EIS to range from $64 - $69 million. This cost estimate includes land acquisition and demolition/relocation costs and assumes that property owners are compensated for their property.

  Full retreat would eliminate the flooding and storm damage threat by removing all development and infrastructure from the affected area. This would reduce, at least initially, the tax base of the city. This might spur new development, however, in adjacent areas of the City not affected by the storm damage threat. The open space created by evacuation could have a positive impact on tourism by providing wide expanses of sandy beach and adjacent open space for beach use, bird watching, wildlife observation and similar activities.

- **Combinations of measures.** Combinations of measures, in addition to those identified above, will be explored. These could include combining direct/onshore beach nourishment with shore parallel structures or with the partial retreat option. As noted above, a complete solution to the storm damage problem must also address overtopping of the north jetty.

The range of costs for addressing the storm damage problems at Ocean Shores varies widely, though there is a fairly good basis for the individual estimates derived from the City's draft EIS. No formal evaluation has been performed to quantify storm-related damages or National Economic Development (NED) benefits to substantiate a benefit-to-cost ratio at this stage of evaluation. Benefit evaluation, together with refinement of costs, is one of the first tasks that should to be addressed in the feasibility study.

6. FEDERAL INTEREST. There are potential solutions to the storm damage problems at Ocean Shores that appear to be economically justified and environmentally acceptable and that would likely be supported by the local sponsor. Benefits are based on a reduction in storm damages incurred over time in the without project condition versus storm damages incurred in the with project condition. Without a project, significant damages are expected to occur to 166 multi-family residential units and 138 single-family residences, as well as electrical power, water, sewer, cable and phone utilities, and streets and roads (11,100 feet of 4-lane roads and 43,160 feet of 2-lane roads). In addition, without the project there will be a loss of land, tourism and recreation and the road to the sewage treatment plant may need to be elevated or armored. Finally, there would likely be some environmental impacts related to the erosion and flooding – such as seawater intrusion into freshwater lakes, wetlands and groundwater. If seawater finds its way into the City's shallow aquifer it will impact the main drinking water supply for two of its wells.

The level of damages incurred without the project and subsequent reduction in damages with a project are a function of shore erosion rates under each condition over time and the value of the damaged property. An indication of the magnitude of potential storm damage reduction benefits is found in the City's draft EIS. It estimates the market value of property (including undeveloped lots) in the expected flood zone to be $60-$65 million, much of which will become a total loss. The market value estimates in the draft EIS, however, do not include the economic value of utilities, roads, personal property (such as household goods, autos, etc.), tourism or recreation or any values associated with environmental impacts or outputs. Since all of these items would be impacted under the without project condition, inclusion of these values will most likely increase project benefits.

Participation by the Corps of Engineers in a cost-shared feasibility study to determine the most appropriate long-term solution to reduce damages to upland developments caused by wind- and tidal-generated waves at Ocean Shores, Washington, is warranted. The project and project purpose (hurricane and storm damage reduction) is in accord with Administration policy and budgetary priorities, as noted in the 9 November 1998 video teleconference fact sheet for FY 1999 work added by Congress. The feasibility study will address the entire storm damage

problem at Ocean Shores, including determining if there is a Federal interest in recommending to Congress the addition of storm damage reduction as an authorized purpose of the Grays Harbor north jetty.

There is strong congressional interest in involvement by the Corps in evaluating the problem and identifying a long-term solution to the storm damage problem, as evidenced by directive language contained in the Conference Report accompanying the FY 2000 Energy and Water Development Appropriations Act. Significant data collection and analysis and has already be accomplished by the City of Ocean shores, and by the State of Washington and the U.S. Geological Survey as part of the Southwest Washington Coastal Erosion Study, thus enabling the time and cost to complete the feasibility study to be kept to a minimum.

7. PRELIMINARY FINANCIAL ANALYSIS. A Letter of Intent from the City of Ocean Shores is attached (see page 17). The letter states the City's ability and willingness to enter into a feasibility cost sharing agreement with the Corps of Engineers and to share in the costs of project construction.

8. SUMMARY OF FEASIBILITY STUDY ASSUMPTIONS. Based on the rather extensive baseline work that has been accomplished to date, a number of feasibility study assumptions can be made as follows:

- The feasibility report will identify and document the most appropriate long-term solution to the storm damage problems confronting the City of Ocean Shores.
- Considerable data and analysis has recently been performed to enable the feasibility study to be completed at a low cost and short duration, based, in part, on the following assumptions.
- The feasibility study will rely heavily on the recent and ongoing data collection and analyses from the Southwest Washington Coastal Erosion Study. This study is developing a regional perspective and understanding of coastal processes, sediment transport, and associated shoreline changes. No additional engineering field data collection is anticipated.
- The feasibility study will utilize the UNIBEST shoreline position modeling performed by the Washington Department of Ecology, subject to further analysis, refinement and validation by Coastal and Hydraulics Laboratory staff at the U.S Army Engineer Research and Development Center and others.
- The economic impact analysis prepared in May 1999 by Battelle Memorial Institute for the City of Ocean Shores will be useful in completing the feasibility report economic benefit evaluation. Quantifying economic benefits will be a high priority of the feasibility study.
- To promote prudent flood plain management, the City of Ocean Shores will develop a flood plain management plan (FPMP) during the preparation of the feasibility study (reference CECW-A/CECW-P Policy Guidance Letter No. 52, dated 8 Dec 1997).
- The NEPA EIS will build upon the Draft State Environmental Policy Act (SEPA) EIS issued by the City of Ocean Shores in May 1999.

- The Corps will prepare an Engineering Appendix to the Feasibility Report. The Appendix will be developed in close coordination with State of Washington coastal engineers and Coastal and Hydraulics Laboratory staff at the U.S Army Engineer Research and Development Center.
- The without-project condition will be predicated on the north jetty having been restored to design dimensions, using FY 2000 Congressional Add funds appropriated for that purpose.
- An MCACES cost estimate will be performed on the selected plan.
- The costs and benefits of all alternatives except the no action alternative will be evaluated on the basis of a 50-year period of economic evaluation at the current WRC interest rate.
- The City of Ocean Shores, with possible assistance from the State of Washington and the Coastal Caucus, has sufficient funding to provide the required combination of cash and in-kind services required for the feasibility study.
- Frequent public workshops and information meetings will be required during the feasibility study to keep the public informed plan formulation and evaluation and to gain public input.

9. FEASIBILITY PHASE MILESTONES. Feasibility phase milestones will be identified in the Project Study Plan that is currently being developed.

10. FEASIBILITY PHASE COST ESTIMATE. The Project Study Plan will fully estimate the time and cost of the feasibility phase study and is currently being developed. A preliminary estimate at this time is that the feasibility study will cost less than $1,000,000. The significant data collection and analysis and has already be accomplished by the Corps and by others in connection with the storm damage issue will minimize the time and cost to complete the feasibility study.

11. RECOMMENDATIONS. The identified tidal flooding and associated storm damage problems at Ocean Shores, Washington, warrant Federal participation in a cost-shared feasibility study. The identified planning objectives are in the Federal interest, are in accord with Administration policy and budgetary priorities, and are strongly supported by the non-Federal sponsor. In addition, Congressional interests have expressed a strong and continuing interest in involvement by the Corps of Engineers in formulating and evaluating the most appropriate long-term solution to reduce damage to upland developments at Ocean Shores caused by wind- and tidal-generated waves and currents. Recommend approval of this Section 905(b) analysis as a basis to complete development and negotiation of the Project Study Plan and to enter into a Feasibility Cost Sharing Agreement with the City of Ocean Shores to conduct the feasibility study.

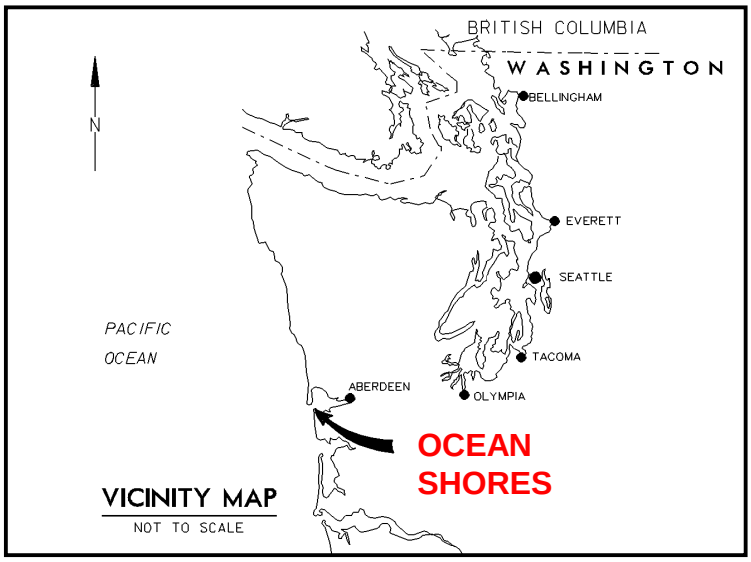
12. POTENTIAL ISSUES AFFECTING INITIATION OF FEASIBILITY PHASE. None. Congress added $100,000 and directive language to the FY 2000 Energy and Water Development Act to initiate the feasibility study at Ocean Shores. The study is in accord with Executive Branch policy and budgetary priorities.

13. VIEWS OF OTHER RESOURCE AGENCIES. A number of state resource agencies participated in the development of the City's May 1999 draft EIS for long-term coastal erosion management strategy and were involved in the preliminary screening of alternative management measures. These included the Washington Department of Ecology, Department of Fish and Wildlife, and the Washington State Parks and Recreation Commission. In addition, State and Federal resource agencies participated in the public review of the draft EIS. Resource concerns related to alternative management measures pertain primarily to consideration of hardened structures (i.e., revetments and bulkheads) along the Washington coast. These concerns will be fully considered in scoping and conducting the feasibility study.

14. PROJECT AREA MAP. A project area vicinity and location map is shown on Figure 1, Page 18. A number of photos of the project area are provided for illustrative purposes on pages 19-25.

JAMES M. RIGSBY
Colonel, Corps of Engineers
Commanding

Letter of Intent dated 14 December 1999
City of Ocean Shores, Washington



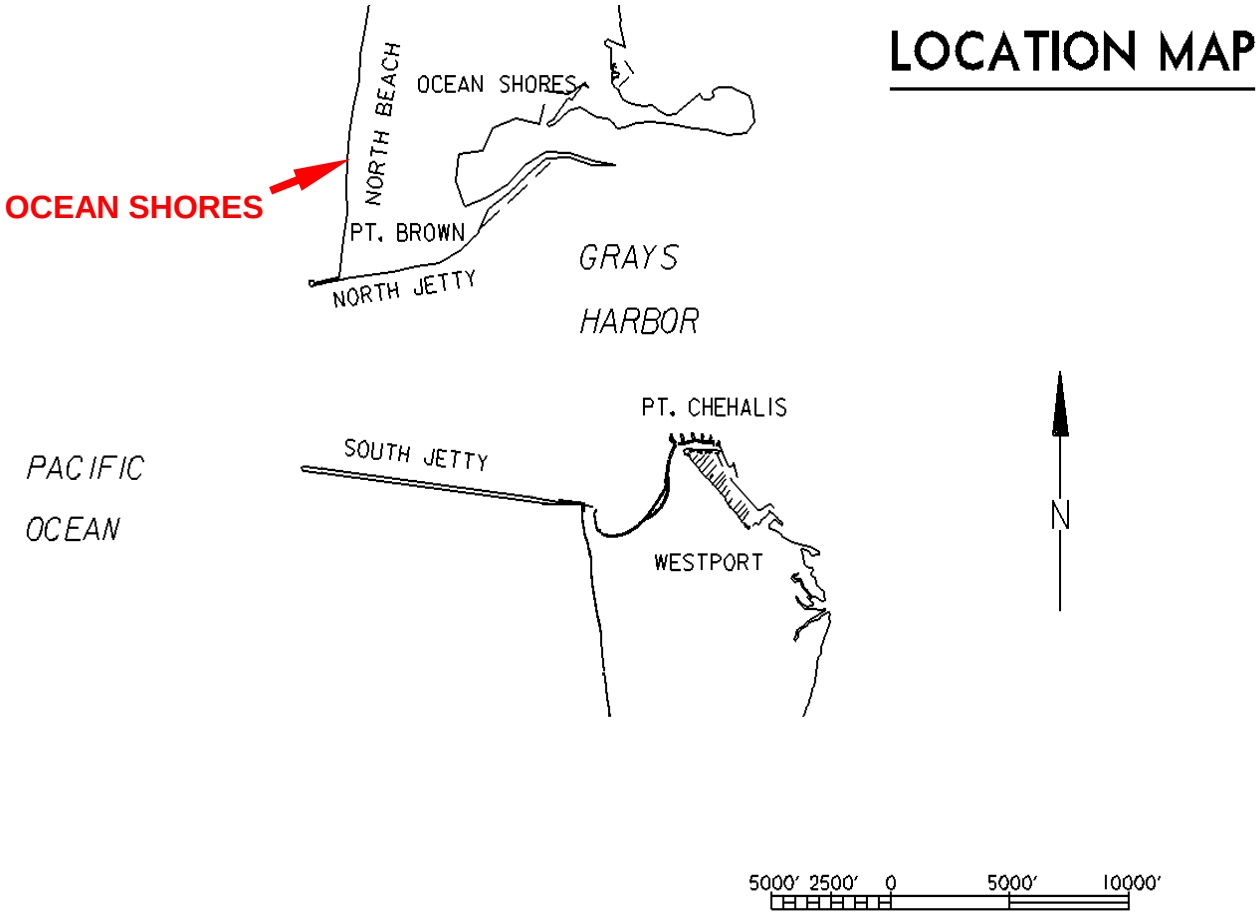


FIGURE 1
OCEAN SHORES, WASHINGTON

PHOTO 1
OCEAN SHORES, WASHINGTON
STORM DAMAGE REDUCTION MANAGEMENT AREA

PHOTO 2
TEMPORARY SHORELINE EROSION CONTROL STRUCTURES

PHOTO 3
FRONTAL DUNE SCARP , LOOKING NORTH (OCTOBER 1996)

PHOTO 4
“WAVE BUMPER” PROJECT, LOOKING SOUTH (FEBRUARY 1998)

PHOTO 5
FLANKING EROSION AT NORTH END OF WAVE BUMPER

PHOTO 6
EROSION OF DUNE SCARP AT NORTH END OF WAVE BUMPER

PHOTO 7
MARCH 3, 1999 STORM WAVES AND EXTREME TIDES COMBINED TO CAUSE MAJOR FLOODING

PHOTO 8
FLOODING DURING MARCH 3, 1999 STORM EVENT

PHOTO 9 – LOOKING EAST
FLOODING OF EAST OCEAN SHORES BLVD, MARCH 3, 1999

PHOTO 10
FLOODING DUE TO MARCH 3, 1999 STORM EVENT

PHOTO 11
PAVEMENT DAMAGE AFTER FLOOD WATERS RECEDED

PHOTO 12 – LOOKING SOUTH AND WEST
FLOODWATERS ON MORNING AFTER THE 3 MARCH 1999 EVENT